Ecodesign of Li-ion batteries

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Current issue

Resource scarcity
Certain materials are expensive, e.g. cobalt or nickel.

Demand for Li-ion battery is increasing
Mainly due to electric vehicle applications. We need to secure supply.

Absence of Li-ion recycling network
Logistic chain is not yet developed.

Recycling for economic purpose
Recycling methods are not necessarily environmentally friendly.

Our objectives

Integrated Design process
That tool would bring together all the stakeholders' constraints, i.e. designers', manufacturers' and especially recyclers' implications along the design process.

Identification of the key design parameters
A key design parameter is a parameter used in the design process, influencing a lot the environmental impacts variations when it is subject to variations (either if they are low).

Create a tool to help in the Li-ion battery ecodesign process
It includes a model to highlight environmental hotspots of the battery lifecycle.

Help to develop Li-ion recycling network in France

Future work

Procurement of end-of-life experimental data
Primary data mesured in laboratory, describing the recycling processes from our partners in LEPMI-Grenoble. These data will refine our battery model.

Understanding relationship between parameters and design issues
Some parameters (variables in the battery model) seem to have connections with other constraint levels. Specify these links is essential to develop the ecodesign tool.

Make the tool accesible to everyone
The approach must be understandable and easy to use by each stakeholder in order to implement a right Integrated Design process.

Context and state of the art

Current studies are mostly based on manufacturing stages
Few studies are focused on the battery end-of-life phase nor in the whole lifecycle. *(Dunn et al. 2012; Laboratory Argonne National et al. 2012)*

Few specific databases for Li-ion batteries
Batteries are modeled with non dedicated databases, using similar industrial activities data. It means inaccuracies of the studies. *(Ellingsen et al. 2013)*

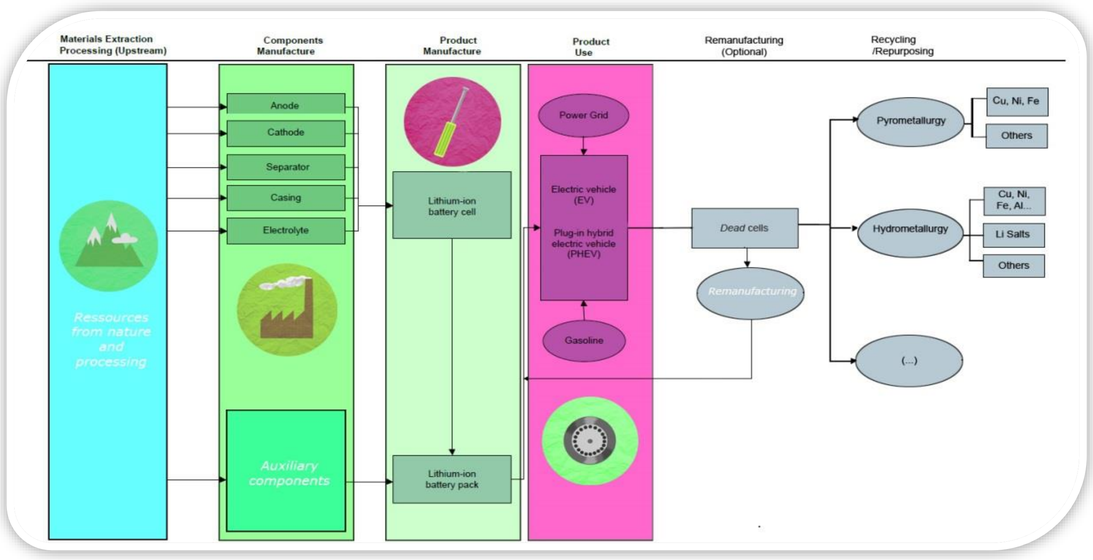
Our work

LCA model of a Li-ion battery
Parameterized and adaptable to each case study. It includes several end-of-life scenarii and battery technologies.

Li-ion battery pack
Our LCA system boundaries includes the battery auxiliary elements: passive cooling system, battery management system and the packaging.

LiFePO4 and Ni-Co-Mn batteries case study
Batteries were modeled, analysed and environmental hotspots were highlighted. Then, we proposed some guidelines to reduce their environmental impact, for instance:

- Use of recycled copper instead of primary copper.
- Maximize copper recovery when recycling.
- Reduce 'dry room' electricity consumption.
- Use a 'greener' electricity grid during manufacturing stages.



Simplified model of Li-ion battery lifecycle
Two recycling methods were included in this case study: hydrometallurgical and direct physical recycling.

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